RBC Antigens & Blood Products

Directed by m-azad

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Table 15.1 Human blood group systems.

No.	Name	Symbol	No. of antigens	Gene name(s)	Chromosome	CD number
001	ABO	ABO	4	*ABO*	9	
002	MNS	MNS	46	*GYPA, GYPB, GYPE*	4	
003	P	P1	1	*P1*	22	CD235a/b
004	Rh	RH	50	*RHD, RHCE*	1	
005	Lutheran	LU	19	*BCAM*	19	CD240D/CE
006	Kell	KEL	31	*KEL*	7	CD239
007	Lewis	LE	6	*FUT3*	19	CD238
008	Duffy	FY	6	*DARC*	1	CD234
009	Kidd	JK	3	*SLC14A1*	18	
010	Diego	DI	21	*SLC4A1*	17	CD233
011	Yt	YT	2	*ACHE*	7	
012	Xg	XG	2	*XG, CD99*	X/Y	CD99
013	Scianna	SC	7	*ERMAP*	1	
014	Dombrock	DO	6	*ART4*	12	CD297
015	Colton	CO	3	*AQP1*	7	
016	Landsteiner–Wiener	LW	3	*ICAM4*	19	CD242
017	Chido–Rodgers	CH/RG	9	*C4A, C4B*	6	
018	H	H	1	*FUT1*	19	
019	Kx	XK	1	*XK*	X	
020	Gerbich	GE	8	*GYPC*	2	CD236
021	Cromer	CROM	15	*CD55*	1	CD55
022	Knops	KN	9	*CR1*	1	CD35
023	Indian	IN	4	*CD44*	11	CD44
024	Ok	OK	1	*BSG*	19	CD147
025	Raph	RAPH	1	*CD151*	11	CD151
026	John Milton Hagen	JMH	5	*SEMA7A*	15	CD108
027	I	I	1	*GCNT2*	6	
028	Globoside	GLOB	1	*B3GALT3*	3	
029	Gill	GIL	1	*AQP3*	9	
030	RHAG	RHAG	3	*RHAG*	6	CD241

TABLE 35-8

Routine ABO Grouping Results and Phenotype Frequencies

CELLS AGAINST KNOWN ANTISERA		SERUM AGAINST RED CELLS OF KNOWN PHENOTYPE			FREQUENCIES IN U.S. POPULATION, %			
Anti-A	Anti-B	A	B	Interpretation	Caucasian	Black	Native American	Asian
–	–	+	+	O	45	49	79	40
+	–	–	+	A	40	27	16	28
–	+	+	–	B	11	20	4	27
+	+	–	–	AB	4	4	<1	5

Composite figures calculated from Mourant (1976).

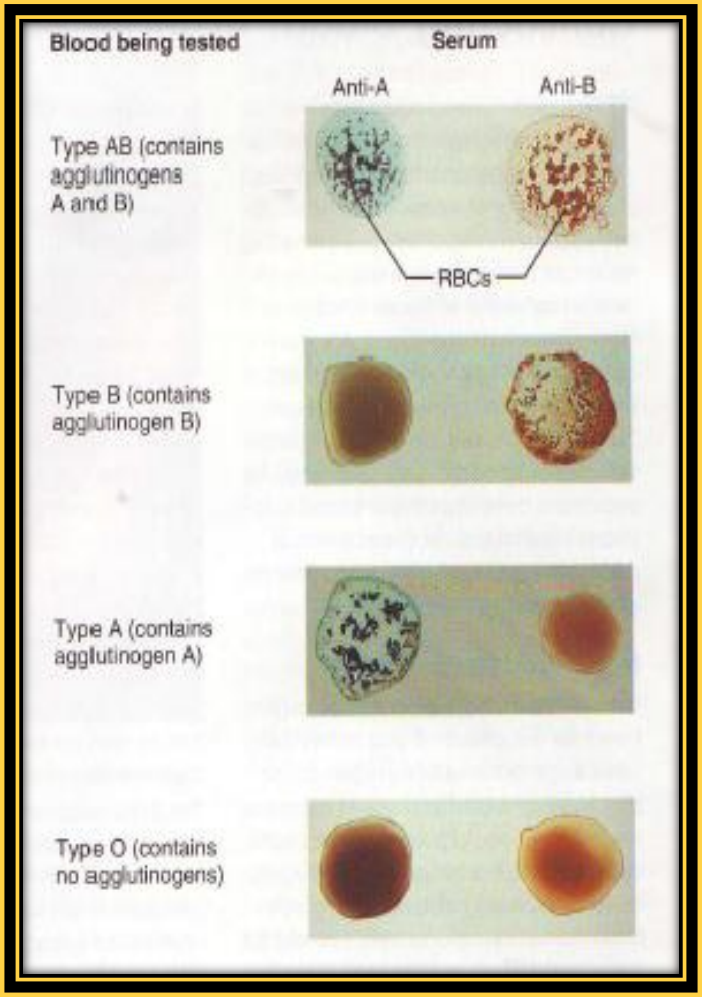

Blood being tested
Serum
Anti-A
Anti-B
Type AB (contains agglutinogens A and B)
RBCs
Type B (contains agglutinogen B)
Type A (contains agglutinogen A)
Type O (contains no agglutinogens)

Table 15.8 Eight Rh haplotypes and their frequencies in English, Nigerian and Hong Kong Chinese populations.

Haplotype			*Frequencies (%)*		
CDE	*Rh-Hr*	*Numerical*	*English*	*Nigerian*	*Chinese*
DCe	R^1	*RH 1,2,–3,–4,5*	42	6	73
dce	*r*	*RH –1,–2,–3,4,5*	39	20	2
DcE	R^2	*RH 1,–2,3,4,–5*	14	12	19
Dce	R^0	*RH 1,–2,–3,4,5*	3	59	3
dcE	r''	*RH –1,–2,3,4,–5*	1	Very rare	Very rare
dCe	r'	*RH –1,2,–3,–4,5*	1	3	2
DCE	R^z	*RH 1,2,3,–4,–5*	Rare	Very rare	Rare
dCE	r^y	*RH –1,2,3,–4,–5*	Very rare	Very rare	Rare

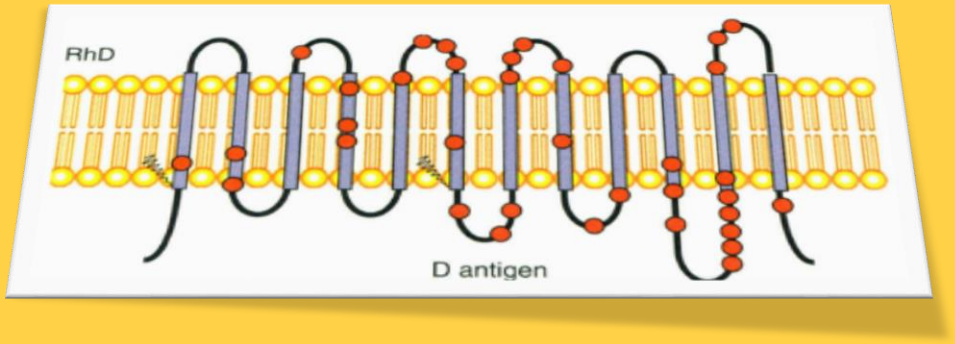


TABLE 35-17

Frequencies of Common Rh Phenotypes*

REACTION WITH ANTI-†					PHENOTYPE		GENOTYPE		FREQUENCIES, n (%)‡			
D	C	c	E	e	Rh	DCE	Rh	DCE	Caucasian	Black	Native American	Asian
+	+	+	+	+	Rh_1Rh_2	DCcEe	R^1R^2	DCe/DcE	0.1176 (89)	0.0374 (100)	0.2992 (89)	0.294 (97)
							R^1r''	DCe/cE	0.0084 (6)		0.0088 (3)	
							$r'R^2$	Ce/DcE	0.0056 (5)		0.0135 (4)	0.0084 (2.8)
							rR^z	ce/DCE		0.0132 (4)	0.0006 (0.2)	
+	+	+	−	+	Rh_1rh	DCce	R^1R^0	DCe/Dce	0.0168 (5)	0.1495 (63)	0.0176 (15)	0.042 (50)
							R^1r	DCe/ce	0.3108 (95)	0.0884 (37)	0.0968 (85)	0.042 (50)
+	−	+	+	+	Rh_2rh	DcEe	R^2R^0	DcE/Dce	0.0112 (10)	0.0968 (63)	0.0136 (15)	0.0126 (50)
							R^2r	DcE/ce	0.1035 (90)	0.0572 (37)	0.0748 (85)	0.0126 (50)
+	+	−	−	+	Rh_1Rh_1	DCe	R^1R^1	DCe/DCe	0.176 (91)	0.029 (81)	0.194 (92)	0.490 (93)
							R^1r'	DCe/Ce	0.017 (9)	0.007 (19)	0.017 (8)	0.028 (7)
+	+	−	+	+	Rh_1Rhz	DCEe	R^1R^z	DCe/DCE		0.053 (100)		
+	−	+	+	−	Rh_2Rh_2	DcE	R^2R^2	DcE/DcE	0.02 (88)	0.012 (100)	0.116 (94)	0.044 (100)
							R^2r''	DcE/cE	0.003 (12)		0.007 (6)	
+	+	+	+	−	Rh2Rhz	DCcE	R^2R^z	DcE/DCE			0.041 (100)	
+	−	+	−	+	Rh_0Rh_0	Dce	R^0R^0	Dce/Dce	0.0016 (5)	0.1936 (46)	0.0004 (8)	0.0009 (33)
							R^0r	Dce/ce	0.0296 (95)	0.2286 (54)	0.0044 (92)	0.0018 (67)
−	−	+	−	+	rhrh	ce	rr	ce/ce	0.1369 (100)	0.0676 (100)	0.0121 (100)	0.0009 (100)
−	+	+	−	+	rh'rh	Cce	rr'	ce/Ce	0.0055 (100)	0.0014 (100)	0.0044 (100)	0.0012 (100)
−	−	+	+	+	rh''rh	cEe	rr''	ce/cE	0.0028 (100)		0.0022 (100)	

Table 143–6 The Incidence of the Principal Rh Haplotypes

Fisher-Race Haplotype	Modified Weiner Haplotype	Incidence (%)		
		White	African Black	Asian
Rh-positive				
DCe	R_1	42	17	70
DcE	R_2	14	11	21
Dce	R_0	4	44	3
DCE	R_z	<0.01	<0.01	1
Rh-negative				
ce	r	37	26	3
Ce	r′	2	2	2
cE	r″	1	<0.01	<0.01
CE	r‴	<0.01	<0.01	<0.01

TABLE 35-18

Molecular Basis for RH and RHAG Antigens

ISBT	Name	Frequency, %	RH protein (D or CE)	Molecular basis (protein or gene exon)	Comments
RH (ISBT 004)					
RH1	D	85–92	D	RHD, loops 3,4,6	
RH2	C	68% Caucasian people 27% black people	CE	Ser103 + Cys16	Antithetical RH4
RH3	E	22–29	CE	Pro226	Antithetical RH5
RH4	c	80	CE	Pro103	Antithetical RH2
RH5	e	80	CE	Ala226 Dependence on Arg229	Antithetical RH3
RH6	f	65	CE	Pro103 + Ala226 Dependence on Arg229	Compound antigen
RH7	Ce	27–28	CE	Ser103 + Ala226	Compound antigen
RH8	C^w	1–2	CE	Gln41>Arg	Antithetical RH51
RH9	C^x	<0.01	CE	Ala36>Thr	Antithetical RH51
RH10	V	30% black people	CE	Leu235>Val, +Gly336	Often with RH20
RH11	E^w	<0.01	CE	Met167>Lys	E variant type I
RH12	G	84–92	D, CE	Ser103	Anti-C+D
RH17	Hr_0	100	CE	RHCE loops 3,4,6	
RH18	Hr	100	CE	Met238	
RH19	hr^S	98	CE	Ala226, Met238	
RH20	VS	40% black people	CE	Leu226>Val	Often with RH10
RH21	C^G	68	CE	Ser103	
RH22	CE	1	CE	Ser103 + Pro226	Compound antigen
RH23	D^w	<0.01	Partial D	Gln233, RHD loop 3,6	
RH26	c-like	80	CE	Gly96 + Pro103	
RH27	cE	22–28	CE	Pro103 + Pro226	Compound antigen
RH28	hr^H	<0.01	?	Unknown	
RH29	Total Rh	100	CE + D	RHD + RHCE	Made by Rh_{null}
RH30	Go^a	2% black people	Partial D	On DIV^a	
RH31	hr^B	98	CE	Unknown	Missing on R2R2
RH32	RN	<1% black people	Partial D	Exons D4–CE5	Antithetical RH46
RH33	Har	<0.01	Partial D	Exons CE4–D5	R_o^{Har}
RH34	Hr^B	100	D + CE	Cys336	
RH35	1114(CeMA)	<0.01	CE	Unclear; CeMA is JAL+	Weak C,e
RH36	Be^a	<0.1	CE	Pro221>Arg	Weak c,e,f
RH37	Evans	<0.01	D–CE hybrid	Exons D6–CE7	
RH39	C-like	100	?	Unknown	On C– and C+ RBCs
RH40	Tar	<0.01	D	Leu100>Pro	
RH41	Ce-like	70	CE	Exon 2, Ala226	
RH42	Ce^S	2% black people	Partial D	Leu245>Val	Associated $dCce^S$
RH43	Crawford	0.7% D- blacks	CE	Gln223>Glu, VS+	ce^S variant; VS+, V+
RH44	Nou	100	?	Unknown	
RH45	Riv	<0.01	Partial D	On DIVa	
RH46	Sec	100	CE	CE exon 4	Antithetical RH32
RH47	Dav	100	CE	Exon 7	
RH48	JAL	<0.01	CE	Arg114>Trp or Glu	Antithetical RH57
RH49	STEM	0.4% Indian people	?	Unknown	
RH50	FPTT	<0.01	Partial D	Exons CE4–D5	
RH51	MAR	>99	CE	Ala36, Gln41	Antithetical RH8,9
RH52	BARC	<0.01	Partial D	Exons CE6–D7	
RH53	JAHK	<0.01	CE	Exon D2 (Ser103), no Cys16	
RH54	DAK	<0.01	Partial D	Unknown	
RH55	LOCR	<0.01	CE	Gly95>Ser	Weak c,e,f ; Rh26±
RH56	CeNR	<0.01	CE–D hybrid	Complex epitope	D– –; RH32+
RH57	CEST	>99	CE	Arg114	Antithetical RH48 (Jal)

Red blood cell compatibility table

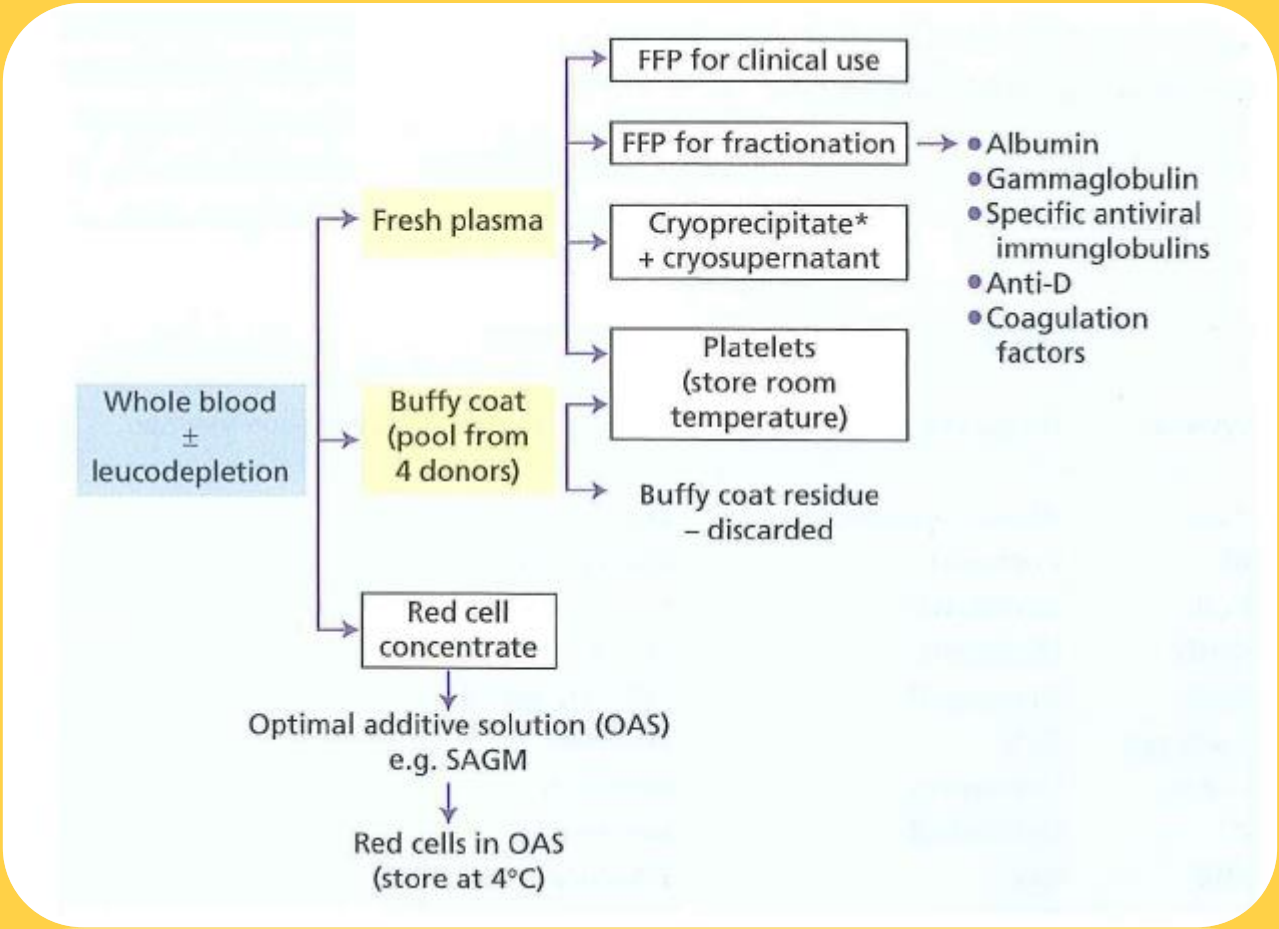
Recipient

Donor

	O-	O+	A-	A+	B-	B+	AB-	AB+
O-	✓							
O+	✓	✓						
A-	✓		✓					
A+	✓	✓	✓	✓				
B-	✓				✓			
B+	✓	✓			✓	✓		
AB-	✓		✓		✓		✓	
AB+	✓	✓	✓	✓	✓	✓	✓	✓

Plasma compatibility table

Recipient	Donor			
	O	A	B	AB
AB				✓
A		✓		✓
B			✓	✓
O	✓	✓	✓	✓


Whole blood
±
leucodepletion
Fresh plasma
Buffy coat
(pool from
4 donors)
Red cell
concentrate
FFP for clinical use
FFP for fractionation
Cryoprecipitate*
+ cryosupernatant
Platelets
(store room
temperature)
Buffy coat residue
– discarded
Albumin
Gammaglobulin
Specific antiviral
immunglobulins
Anti-D
Coagulation
factors
Optimal additive solution (OAS)
e.g. SAGM
Red cells in OAS
(store at 4°C)

WHOLE BLOOD

Plt concentrate

FFP

TABLE 36-3

ABO Compatibility

Donor type	RECIPIENT TYPE			
	O	**A**	**B**	**AB**
O	R P	R R	R	R R
A	P	P	R P	R
B	P		P	R P
AB	P	P	P	

P, Plasma-containing components (platelets, fresh frozen plasma) are compatible;
R, red cells are compatible.


Tnx